REMARKS

A. INTRODUCTION

Applicant has revised the specification on page 1, line 21. Support for the amendment to the specification may be found in the literature, and in the specification (page 10, lines 8-9) and example (ionic conductivity measured at conventional operating temperatures for solid polymer electrolyte fuel cells within the range of 50-80°C). Claims 1, 9, 10, 18, 19, and 23 also have been amended to recite the reinforcing agent begin separate from the ion-exchange polymer, and to recite the mixture of ion-exchange polymer and reinforcing agent being present as a slurry. Support for these amendments can be found in the original claims by virtue of separately claiming an ion-exchange polymer and a reinforcing agent using the conjunction "and." Additional support is provided in the specification and examples by virtue of the composition containing the ion-exchange polymer and the reinforcing agent being a slurry of the two components. No new matter is presented by the amendments, the amendments simplify issues for appeal by removing an objection to the specification and rejection of the pending claims. Accordingly, applicant respectfully requests entry thereof and reconsideration of claims 1-23 in light of the following remarks.

Claims 1-23 are pending in this application. Applicant notes with appreciation the Examiner's withdrawal of the previous rejection under 35 U.S.C. §112, second paragraph, as noted on page 2 of the Action. Claims 1-3, 6-12 and 15-23 remain rejected under 35 U.S.C. §102(b) as anticipated by Bahar *et al.* Claims 1, 2, 5-11 and 14-23 remain rejected under 35 U.S.C. §102(b) as anticipated by Grot *et al.* Claims 1-4, 8, 10-13, 17 and 19 remain rejected under 35 U.S.C. §103(a) as being unpatentable over Watanabe *et al.*, in view of Grot *et al.* Applicant respectfully submits that all of the pending claims are allowable for the reasons that follow.

B. REJECTION UNDER 35 U.S.C. § 102 (b)

On pages 2-4 of the Action, claims 1-3, 6-12 and 15-23 were rejected under 35 U.S.C. § 102 (b) as being anticipated by Bahar *et al.*, U.S. Patent No. 5,635,041 ("Bahar"). The Action asserts that "[r]egarding claims 1-3, Bahar teaches a composite membrane comprising a base material 4 and an ion exchange material/resin 2. The base material is a porous microstructure (porous support) and the ion exchange resin impregnates the membrane, *i.e.* base material (col. 3, lines 29-40)." *See*, Action at page 3. The Action further alleged that the ion exchange materials may optionally be complemented by finely divided powders or other (non-ionic) polymers to provide final composites, and that such a finely divided powder may be selected from organic or inorganic compounds such as, but not limited to, carbon black, graphite, nickel, silica (SiO_2), titanium dioxide (TiO_2) or platinum black (catalyst). It was further asserted that the powders provide specific added effects such as electrical conductivity, thermal conductivity, catalytic effects and/or enhanced or reduced reactant transport properties, citing col. 4, line 66 to col. 5, line 8 of Bahar. Finally, the Action noted that "silica and titanium dioxide were moisture retentive materials and platinum was a catalyst as described in the instant specification (page 9, lines 9-21)." Action, at page 3.

Applicant respectfully traverses this rejection. Bahar discloses a composite membrane comprising a base material such as a polytetrafluoroethylene membrane having a porous microstructure of polymeric fibrils wherein an ion exchange material is embedded into the porous membrane. See, col. 3, lines 29-30. Bahar discloses that the ion exchange material may also be comprised of at least in part a powder, such as but not limited to, carbon black, graphite, nickel, silica, titanium dioxide, and platinum black. See col. 2, lines 58-61. The examples of Bahar do not employ a these polymer additives, but rather use a native ion-exchange polymer without additional powder. Bahar discloses that the finely divided powders or other non-ionic polymers used to provide final composites provide added effects

such as different aesthetic appearance (color), electrical conductivity, thermal conductivity, catalytic effects or enhanced or reduced reactant transport properties. See, col. 5, lines 2-8. Bahar fails to disclose a reinforced composite ionic conductive polymer membrane as recited in the present claims.

Applicant's invention as recited in claim 1 is directed to a reinforced composite ionic conductive polymer membrane which has improved ionic conductivity, improved moisture retention, and reduced cross over of liquid fuel by the addition of a reinforcing agent that in turn improves the overall efficiency of the fuel cell. Applicant's reinforced composite ionic conductive polymer membrane comprises: a porous support; an ion exchange polymer that impregnates the porous support; ***and*** a reinforcing agent that impregnates the porous support. The reinforcing agent is at least one selected from the group consisting of a moisture retentive material and a catalyst for facilitating oxidation of hydrogen. Bahar fails to disclose a separate reinforcing agent. The examples of the present specification illustrate the superior results achieved when a separate reinforcing agent is used together with the ion-exchange polymer. Indeed, applicant's comparative examples are similar to the preferred embodiments disclosed in Bahar, and in the other prior art documents cited in the rejections discussed below.

Even if Bahar discloses that the ion exchange polymer is embedded into a porous support base such as polytetrafluoroethylene, Bahar fails to specifically teach the addition of a "reinforcing agent" in addition to the ion-exchange polymer. Rather, Bahar discloses powders and other complementary materials that are incorporated into the ion-exchange polymer. Because these materials are incorporated into the ion-exchange polymer, they are not available as a reactant to reinforce the membrane and provide moisture-retentive effects. Thus, Bahar fails to disclose or suggest a reinforcing agent selected from the group consisting of a moisture retentive material and a catalyst for facilitating oxidation of hydrogen in

addition to the ion-exchange polymer. Bahar therefore fails to disclose all of the features recited by the presently claimed invention, and accordingly, claim 1 and its dependent claims are allowable over Bahar.

On pages 4-6 of the Action, claims 1, 2, 5-11 and 14-23 were rejected under 35 U.S.C. § 102 (b) as being anticipated by Grot *et al.*, U.S. Patent No. 5,919,583 ("Grot"). The Action alleges that regarding claims 1, 2, 6, 7, 10, 11, 15, 16, 19 and 21, "Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler." Action, at page 4. The Action also alleges that "the inorganic filler is an inorganic proton conductor selected from the group consisting of titanium dioxide, tin and hydrogen mordernite, oxides and phosphates or zirconim, and mixtures thereof." *Id.*, at pages 4 and 5. The Action further noted that "titanium dioxide, zirconium oxide, mordernite and zeolite are moisture retentive materials, as described in the instant specification (page 9, lines 9-21). *Id.*, at page 5.

Applicant respectfully traverses this rejection. Grot discloses cation exchange polymer membranes having cation exchange groups and inorganic fillers dispersed therein that exhibit reduced fuel crossover. The inorganic filler groups are selected from a group consisting of titanium dioxide, tin and hydrogen mordenite, oxides and posphates of zirconium, and mixtures thereof. Like Bahar, Grot fails to disclose the use of a reinforcing agent in addition to the ion-exchange polymer. Rather, these documents merely describe conventional fillers and additives incorporated into polymers. Incorporating these fillers and additives into the ion-exchange polymer is not the same as adding a reinforcing agent as an additional component of the composite ionic conductive polymer membrane. This feature is borne out in the examples in the present specification where it is shown that separately added reinforcing agents provide superior properties. Accordingly, Grot does not disclose all of the

features recited in the present claims. Applicant respectfully requests that the Examiner reconsider and withdraw this rejection.

Dependent claims 2 and 5-9 that directly depend from claim 1 also are allowable. In a similar fashion, claims 10, 11, and 14-23 are all in condition for allowance because the polymer composite is novel as is its use in a hydrogen and a direct methanol fuel cell.

C. REJECTION UNDER 35 U.S.C. § 103

On pages 6-8 of the Action, claims 1-4, 8, 10-13, 17 and 19 were rejected under 35 U.S.C. §103 (a) as being unpatentable over Watanabe *et al.*, US Patent No. 5,766,787 (Watanabe) in view of Grot. The Action alleges that "Watanabe teaches a solid polymer electrolyte fuel cell comprising a solid polymer electrolyte membrane incorporating 5.8% platinum catalyst and 5 wt% silica in Nafion (perfluorocarbon sulfonic acid cation exchange resin) or 5.8 wt% platinum catalyst and 5 wt% titania (TiO_2) in Nafion." Action, at page 6. The Action alleges that "the platinum catalyst is about 54 wt%, and the silica (or titania) is about 46 wt % of the total amount of catalyst plus metal oxide (reinforcing agent) contained in the polymer electrolyte membrane." *Id.* The Action alleges further that the "membrane comprises 0.01-80 wt% of at least one metal catalyst (Pt, Au, Pd, Rh, Ir and/or Ru) and 0.01-50 wt% of particles and/or fibers of at least one metal oxide (silica, titania and/or zirconia). *Id.*

The Action recognizes that Watanabe does not explicitly state that the polymer electrolyte membrane includes a porous support, but alleges that Grot teaches a cation exchange membrane made from a polymer having cation exchange groups and containing inorganic filler. Based on these combined teachings, the Action concludes that "the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because one of skill would have been motivated to incorporate a porous

support in the polymer electrolyte membrane of Watanabe in order to improve the mechanical properties and/or decrease the cost of the membrane." Action, at page 7.

Applicant respectfully traverses this rejection. Even if these teachings were combined as alleged in the Action, the combination would not result in the presently claimed invention. Rather, the combination would result in, at best, an ion-exchange polymer containing conventional additives and fillers, and a porous support. No additional reinforcing agent is disclosed or suggested by the cited art. Indeed, the prior art cited in the Action teaches directly away from adding the reinforcing agent as a separate component by disclosing the addition of certain fillers and additives into the ion-exchange polymer. As stated above, incorporating additives and fillers into an ion-exchange polymer is not the same as adding a separate reinforcing agent that impregnates the porous support, as recited in the present claims. The combination of Watanabe and Grot therefore fail to render obvious the present invention as claimed in claims 1-4, 8, 10-13, 17 and 19. Applicant respectfully requests that the Examiner reconsider and withdraw this rejection.

D. CONCLUSION

In view of the foregoing amendments and remarks, applicant respectfully submits that the present application is in condition for allowance.

If the Examiner believes that additional discussions or information might advance the prosecution of the instant application, the Examiner is invited to contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.

In view of the foregoing remarks, favorable reconsideration is respectfully requested, and an early notice of allowance is hereby requested.

Respectfully submitted,

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PETITION and
DEPOSIT ACCOUNT CHARGE AUTHORIZATION

This document and any concurrently filed papers are believed to be timely. Should any extension of the term be required, applicant hereby petitions the Director for such extension and requests that any applicable petition fee be charged to Deposit Account No. 50-1645.

If fee payment is enclosed, this amount is believed to be correct. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-1645.

Any additional fee(s) necessary to effect the proper and timely filing of the accompanying-papers may also be charged to Deposit Account No. 50-1645.